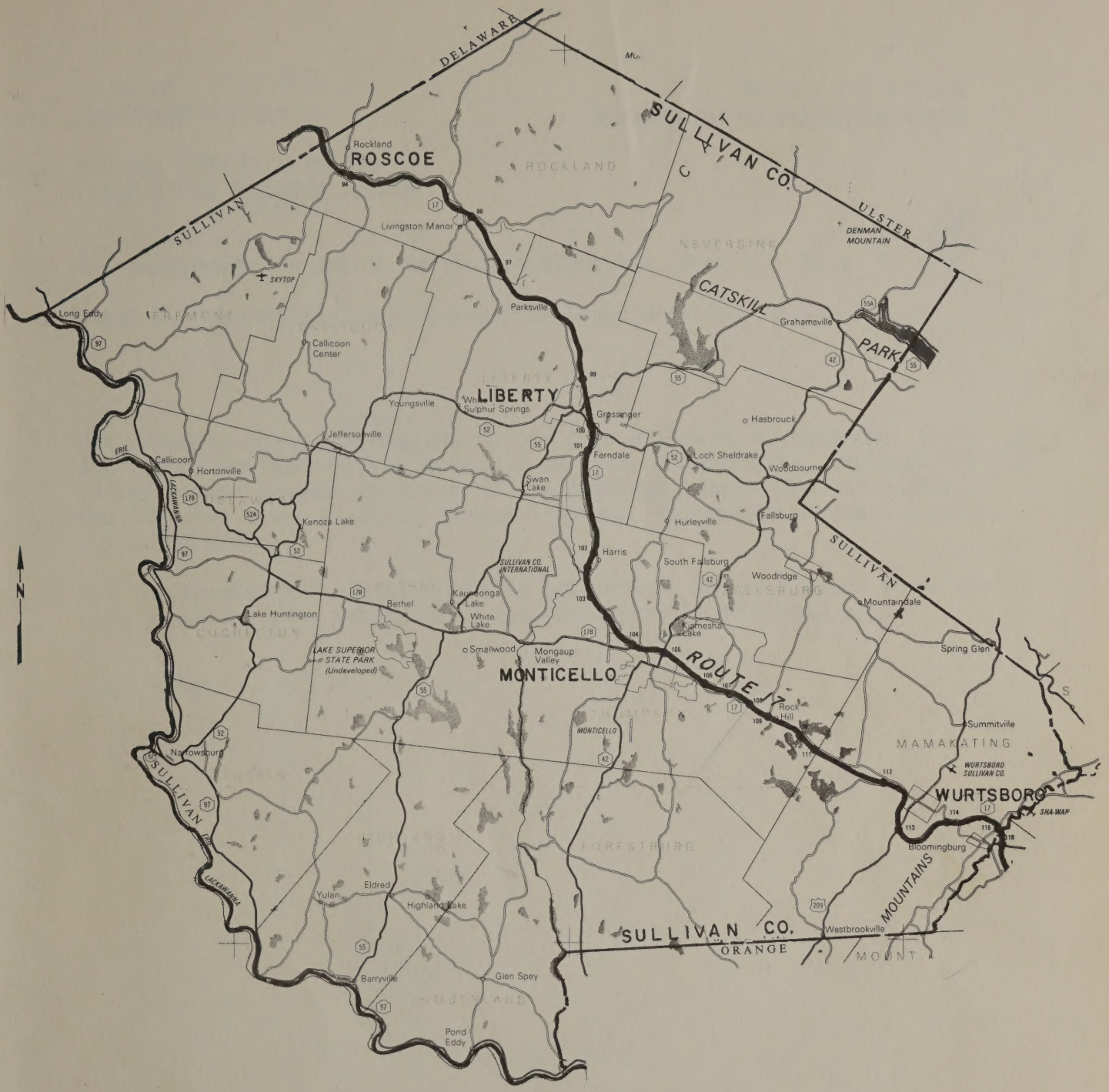


Roadway Condition Report
Route 17 In Sullivan County

SEPT. 1979

STATE OF NEW YORK
DEPARTMENT OF TRANSPORTATION

MEMORANDUM
DEPARTMENT OF TRANSPORTATION

DATE ~~September 10, 1979~~ MARCH 19, 1983

SUBJECT ROADWAY CONDITION REPORT
ROUTE 17 IN ~~SULLIVAN~~ BROOME COUNTY

FROM ~~Wm. P. Hofmann~~ L. H. MOORE, Technical Services Subdivision, Room 210, Bldg. 7A

TO James K. Connors, Regional Director of Transportation, Region 9

All of Route 17 in ~~Sullivan~~ BROOME County has been evaluated by personnel from the Region and Main Office Technical Services Subdivision. Emphasis was placed on the present condition of the Portland cement concrete pavement; particularly joint faulting, pavement blowup, transverse pavement cracking and joint seals.

The recommended problem solutions in this report are considered to be the most practical ones available at the present state of technology.

WPH:WPM:MR

OK

TABLE OF CONTENTS

Page

I. INTRODUCTION

A joint Regional-Main Office Technical Services group has made an evaluation of all of Route 17 in ~~Sullivan~~ County. The investigation included a review of the as-built contract plans, field inspections and ~~some pavement and shoulder coring. Also included in the evaluation is the present condition of all earth and rock slopes and surface drainage.~~

Route 17 in ~~Sullivan~~ County is approximately ~~45~~ miles long. This four lane divided pavement is 9 inch thick reinforced Portland cement concrete with transverse joints at nominal 60 or 100 foot spacing. Each joint has a two component load transfer device, ~~generally of the "Acme" type design.~~ This portion of Route 17 was constructed under ~~11~~ contracts that were let between ~~1950 and 1965.~~ Many of these pavement sections have reached or exceeded their design life. Some have been overlaid with asphalt concrete or are being planned for some rehabilitation work in the near future.

This report identifies existing major problems and recommends potential solutions for them. The report is sufficiently detailed to allow development of a strategy for the maintenance of pavement rideability and the prevention of further deterioration. Additional investigations will be necessary for any subsequent design work for rehabilitation contracts.

42 Miles - Broome
9 CONTRACTS.

Del. ~~35.4~~ Miles Del. Co.
1952 & 1965 6 contracts.

II. BACKGROUND INFORMATION

New York State has many miles of 9 inch thick Portland cement concrete pavement which is reaching its design life or has already passed it. Much of this pavement has the "~~Acme~~" type load transfer devices. This load transfer device deteriorates with time resulting in variable degrees of pavement faulting. This problem was thoroughly investigated and reported in March 1978, in a report entitled "Portland Cement Concrete Pavement Performance - Interstate 84, Pennsylvania State Line to Connecticut State Line." The findings in this report should be considered in conjunction with this Route 17 report. The future field investigation work necessary for the proper design of rehabilitation contracts can be minimized by utilizing the knowledge learned from the I-84 investigation.

OK

III. OBSERVATION OF GENERAL ROADWAY CONDITIONS

Prior to making a field inspection of the roadway, the original construction contract limits, pavement and shoulder details and geometric data were obtained from the record plans. The Pavement Rideability Index (PRI) values from the ~~1977~~ 1981 Survey were also obtained. ~~These readings were taken in the right hand travel lane at the posted speed. Data from the 1978 Survey will be available soon.~~

BETWEEN JUNE AND OCTOBER 1982

~~In June and July~~ 1979, several inspections of Route 17 were conducted. Materials Bureau personnel were primarily concerned with the pavement conditions and Soils Bureau personnel were primarily concerned with the shoulder, earth and rock slopes, and surface drainage conditions. ~~Some pavement cores were obtained to verify the type of load transfer device and to determine its condition.~~ Shoulder cores were taken at random locations to determine the materials presently in place. Engineering Geologists from the Soil Mechanics Bureau inspected all the rock cut slopes ~~with the Assistant Resident Engineer.~~

THE

The information gathered from the above activities is presented separately for each original construction contract. The preliminary rock cut slope recommendations ~~and the shoulder core records are~~ located in the Appendix.

AND THE SHOULDER ~~CORE~~

AND THE SHOULDER CORE RECORDS ARE

FARC 65-151, EAST BRANCH - SULLIVAN COUNTY LINE, PART 2

ROUTE MILE MARKER 17-9609 - 1000 TO 1013

PAVEMENT

Features

- Portland cement concrete pavement, 60 foot nominal slabs.
- Saw cut longitudinal and transverse contraction joints with neoprene sealer.
- Burlap texture.

Field Observations

The pavement and joints are generally in good condition. Minor joint faulting, about 1/8 inch in driving lane, and none in passing lane. Slight pavement wear in driving lane wheel paths.

Pavement Rideability Index

Eastbound - Of the 1.235 miles total, 1.081 miles was measured and it had a mean PRI of 2.37.

Westbound - This roadway was not surveyed.

SHOULDER

Record Plan Details

- Material - Item 51MX - Asphalt Concrete (Item 59WWA, Bituminous Stabilized Course, was eliminated from the contract).
- Thickness - 4 inches
- Outside Width - 10 feet
- Median Width - 4 feet

Results of Shoulder Coring

Shoulder cores were not obtained from this contract.

Field Observations

General Evaluation - Good

Outside Shoulder

- The surface wearing course is intact.
- A slight drop-off exists at the edge of pavement - maximum 1/2 inch.
- Typical longitudinal cracking exists in the shoulder to an average width of 8 inches - maximum 24 inches.

Median Shoulder

- Good

FARC 64-109, LIBERTY - COUNTY LINE, PART 2, ROSCOE - DECKERTOWN

ROUTE MILE MARKER 17-9609 - 1013 TO 1074

PAVEMENT

Features

- Portland cement concrete pavement, 60 foot nominal slabs.
- Saw cut longitudinal and transverse contraction joints with neoprene sealer.
- Burlap texture.

Field Observations

The pavement is generally in good condition. However, there is objectionable transverse joint faulting present, which noticeably affects the ride. The joint faulting is more severe in the driving lane, ranging from 1/4 to 1/2 inches. The faulting in the passing lane ranges from none to 1/4 inch. There are a few short slabs (25 feet) near the mainline bridges at Exit 96 that have severe faulting of as much as 1-1/2 inches. This faulting has progressed to this amount since the slabs have separated. Pressure relief joints installed to protect the bridges have initiated the slab separation.

Cores taken in the transverse joints on this project show that the load transfer devices have corroded and failed. The base of the iron slot has broken away and left the stub end unsupported. See Photo Nos. 1, 2, 8, 9 and 10.

There were also transverse cracks noted at all the survey locations which were at one mile intervals. Some of these cracks were due to culverts at these locations, while other cracks had no readily apparent cause. These cracks may be due to binding in the transverse joints and/or related to the joint faulting. Faulting was not noted at these transverse cracks.

A few blowup repairs were noted on this project. Also noted was that many of the transverse joints have closed from their original 3/8 inch opening to as little as 3/16 inches. Other transverse joints have opened from 1/2 to 3/4 inches. This shows that incompressibles are filling some of the joints causing expansive pressures with the likelihood of additional blowups occurring in the future.

There is slight pavement wear exposing some coarse aggregate in the driving lane wheel tracks; none in the passing lane.

Pavement Rideability Index

Eastbound - The complete 5.799 miles was surveyed and has a mean PRI of 1.46. Almost none of the roadway was above 2.40.

Westbound - This roadway was not surveyed.

SHOULDER

Record Plan Details

- Material - base course Item 59WW, Bituminous Stabilized Course; wearing course not detailed.
- Thickness - 4 inches
- Outside Width - 8 feet
- Median Width - 4 feet

Results of Shoulder Coring

Five cores indicated that a 59WW base course, varying in thickness from 1-1/2 to 3 inches, was used. Several different wearing courses were encountered including a 1/2 inch thick double surface treatment, a 2 inch thick dense binder course and a 1-1/2 to 2-1/2 inch thick top course. The total thickness of shoulder section varied from 3 to 5 inches.

Field Observations

General Evaluation - Good

Outside Shoulder

- The surface wearing course is intact.
- A slight drop-off exists at the edge of pavement - maximum 1/2 inch.
- Typical longitudinal cracking exists in the shoulder to an average width of 6 inches - maximum 12 inches.

Median Shoulder

- Good - no evidence of cracking or drop-off.

EARTH CUT SLOPES

EB 1029-1030

A portion of a large cut slope at this location has sloughed into the ditch blocking the drainage. The failed area is approximately 100 feet wide by 30 feet high.

FARC 61-132, LIBERTY - COUNTY LINE, PARTS 1 AND 2

ROUTE MILE MARKER 17-9609 - 1074 TO 1109

PAVEMENT

Features

- Portland cement concrete pavement, 60 foot nominal slabs.
- Saw cut longitudinal and transverse contraction joints with both liquid and neoprene sealer.
- Burlap Texture.

Field Observations

The pavement on the project is generally in good condition. Some short sections of the pavement have been overlaid by Maintenance. It is similar to the adjacent western project FARC 64-109. Joint faulting is also present here. Faults in the driving lane range from 3/8 to 1/2 inch, and are about 1/8 inch in the passing lane.

This project exhibited many intermittent areas of cracking which meandered across the longitudinal joint, starting and ending at the joint. It was noted at a few areas of spalling at the crack and joint that the longitudinal saw cut was 1-1/2 to 1-3/4 inches deep. The saw cut did not initiate the crack, rather the full depth crack occurred away from the joint. It may be that the saw cut was done too late, after the pavement had cracked in this pattern. Current practice is to use a deeper saw cut of 2-3/4 inches to initiate the cracking and saw at an earlier time than in the past specification.

There is slight pavement wear in the driving lane wheel tracks; none in the passing lane. Sections of pavement have been grooved longitudinally.

Pavement Rideability Index

Eastbound - All of the 3.402 miles was surveyed and has a mean PRI of 1.09. The 2.961 miles of concrete pavement had a mean PRI of .88 while the .441 miles of overlaid pavement had a mean PRI of 2.47.

Westbound - This roadway was not surveyed.

SHOULDER

Record Plan Details

- Material - Base Course Item 59TCM, Stabilized Gravel - Mixed Bituminous Treatment; wearing course not detailed.

- Thickness - 3 inches
- Outside Width - 8 feet
- Median Width - 4 feet

Results of Shoulder Coring

Four shoulder cores were obtained. The shoulder section consists of 1-1/2 to 2 inches of top course with several cores having a surface treatment above the top course. Underlying the top course is gravel.

Field Observations

General Evaluation - Good to Fair

Outside Shoulder

The surface wearing course is intact to 6 feet out from the pavement edge; the outside 2 feet is generally non-existent because of erosion caused by concentrated surface drainage. Abrasive sand has accumulated outside the shoulder forming a berm.

A variable depth drop-off exists at the edge of pavement - maximum 1 inch. Typical longitudinal cracking exists in the shoulder to an average width of 8 inches - maximum 18 inches.

Median Shoulder

- Good

FARC 50-10, LIBERTY - COUNTY LINE, PART 1

ROUTE MILE MARKER 17-9609 - 1109 TO 1127 (PARKSVILLE LIGHT)

PAVEMENT

Features

- Portland cement concrete pavement, 95 foot nominal length slabs.
- Formed transverse expansion joints.
- Asphalt Overlay.

Field Observations

The concrete pavement on this project has been overlayed with asphalt concrete at some indeterminate time(s) in the past. The overlay consists of about 3/4 inches of a top course mixture, which in turn was overlayed with a 1-1/2 inch course of open binder and a 1 inch thick top course.

The overlay ride is smooth. However, there is reflective cracking at all the longitudinal and transverse joints. This cracking has allowed water into the layer of open binder which has caused alligator cracking in the top course which has broken up in the areas of the transverse joint. There are patches by Maintenance forces that fill in these areas where traffic has broken away the asphalt. See Photo No. 3.

A core in one of the transverse joints shows that it is a formed expansion joint. It has approximately 1/4 inch of an asphalt material for its full depth to provide a sealer and allow for expansion. The transverse joint load transfer device is an unknown type, but resembles the hairpin dowels in Figure 7 in Physical Research Report RR-66-2. See Page 25. The presence of joint faulting could not be determined from this core. However, the use of this joint type was discontinued due to severe faulting problems.

Pavement Rideability Index

Eastbound - Only 1.695 miles of the 1.849 miles on this section was surveyed. The mean PRI was 1.03.

Westbound - This roadway was not surveyed.

SHOULDER

Record Plan Details

- Material - Not detailed.
- Thickness - Not detailed.

- Outside Width - 8 feet
- Median Width - 2 feet

A subsequent contract, RCR 74-91, included the reconstruction of the shoulder in this area.

Results of Shoulder Coring

Four shoulder cores were obtained. The shoulder section consists of a surface treatment over 1-1/4 to 2 inches of top course over 1-1/2 to 3 inches of open base course over gravel. One core encountered 2-1/4 inches of open graded fine binder over 3-1/3 inches of dense graded fine binder. The total thickness of the shoulder section varied between 2-3/4 and 7-1/2 inches.

Field Observations

General Evaluation - Good

Outside Shoulder

- Surface wearing course intact.
- No drop-off.
- No cracking.

Median Shoulder

- Good

FARC 56-87, MONTICELLO - LIBERTY, PART 2; LIBERTY VILLAGE
LIBERTY - COUNTY LINE, PART 1
ROUTE MILE MARKER 17-9609 - 1127 TO 1186

PAVEMENT

Features

- Portland cement concrete pavement, 95 foot nominal length slabs 2000 feet west to east.
- Concrete pavement, 60 foot nominal length slabs for remainder of the project.
- Sections of this project have been overlaid and are noted below.

Field Observations

Asphalt Overlay (MP 1127 to MP 1156, 2.9 miles)

The asphalt overlay on this portion of the original project is approximately 1 year old having been placed in 1978. The overlay consists of a 1 inch minimum of trueing and leveling course followed by 1-1/2 inches of dense binder course and 1 inch of top course. Due to the thickness of the trueing and leveling, the overlay depth in many places is 4 to 5 inches.

At the time of inspection only a few of the transverse joints have reflected. The ride is smooth. All transverse reflection cracks are tight, 1/16 inch or less in width.

Asphalt Overlay Under Construction Contract D95942 - Exit 99, MP 1155 to Exit 100, MP 1177 (2.2 miles)

This section of the original project is being overlaid with a minimum 2-1/2 inches of trueing and leveling course with a 1 inch thick top course.

Concrete Pavement - Exit 100, MP 1177 to MP 1186 (0.8 miles)

100 foot nominal slabs, formed longitudinal and transverse joints with liquid sealer.

This section shows many types of failures. There is transverse joint faulting of 1/4 inch in the driving lane and 1/8 inch in the passing lane.

There was one blowup repair noted.

The longitudinal joint has separated to an inch wide due to a blowup nearby. The blowup or buckled pavement which was in a single lane relieves the expansion pressures in that lane of pavement. The slabs on either side of the blowup, usually for approximately 500 feet, move in toward the buckled pavement. This occurs in only the lane where the blowup occurs. The adjacent lane remains stationary. During this movement the longitudinal joint ties pull apart and bend as the slabs move. These ties are of two piece construction with threaded connectors and have been weakened by corrosion. Cores have confirmed this; see Photo Nos. 4, 5, 6 and 7. Once the longitudinal tie has been lost, abrasive sands fill the joint causing the slabs to spread apart.

Another failure noted in this section is that many transverse cracks were evident. These occurred at about 15 foot intervals and have faulted as aggregate interlock has been lost through pavement movement. This faulting has created an objectionable ride.

Pavement Rideability Index

Eastbound - Almost all of the 5.852 miles on this section was surveyed and had a mean PRI of 2.36. The 2.931 miles of rigid pavement had a mean PRI of 1.07 and the 2.733 miles of overlaid pavement had a mean PRI of 3.75.

Westbound - This roadway was not surveyed.

SHOULDER

Record Plan Details

- Material - Item 259GS, Calcium Chloride Treated Shoulder.
- Thickness - 6 inches
- Outside Width - 11 feet - 6 inches (treated width)
- Median Width - 4 feet Item 259LS

Results of Shoulder Coring

Only one shoulder core was obtained. The shoulder section consisted of 1-1/2 inches of top course over 3 inches of open base course.

Under Contract D95467 - MP 1135 to MP 1140 - the following evaluation applies.

Four cores were obtained on this section. They show 1 to 1-1/2 inches of top course over 3 to 3-3/4 inches of open binder. The total thickness of shoulder section varied from 4-1/4 to 4-3/4 inches.

Field Observations

General Evaluation - MP 1127 to 1157

- Resurfaced under Contract D95467
- Excellent condition

MP 1157 to 1178

- Recently resurfaced under Contract D95942
- Excellent condition

MP 1178 to 1186

- Fair condition

Outside Shoulder

The surface wearing course is intact for the entire project length. From MP 1178 to MP 1186, Maintenance now wedging for correction of drop-off problem.

Median Shoulder

- Fair
- There is a variable drop-off, but the wearing course is generally intact.

FARC 58-104, MONTICELLO - LIBERTY, PARTS 1 & 2

ROUTE MILE MARKER 17-9609 - 1186 TO 1267

PAVEMENT

Features

- Portland cement concrete pavement, 60 foot nominal length slab.
- Formed longitudinal and transverse contraction joints with liquid sealer.

Field Observations

The transverse joints in this concrete pavement show faulting in the driving lane of 1/8 to 3/8 inches and in the passing lane from 0 to 1/4 inches. The ride is objectionable due to this faulting.

Transverse cracks are present, most are tight, but faulting in some areas has added to the objectionable ride.

There are approximately 45 blowups in this section. Blowups are both single and multiple lane in width.

The width of the transverse joints vary from 1 inch to 1-3/8 inches. Most are well sealed with liquid sealer. It appears the joints have filled with dirt and sand which, with time, have caused the blowups.

The longitudinal joint has separated in many areas due to the blowups and slab displacements in a single lane. Separations of up to 1-1/2 inches were noted.

There is pavement wear in the driving lane wheel paths. The wear has exposed the coarse aggregate and has left a textured surface. Some sections of pavement have been grooved longitudinally.

Pavement Rideability Index

Eastbound - All of the 8.013 miles was surveyed and had a mean PRI of 1.47.

Westbound - The total mileage of 7.994 miles was surveyed and had a mean PRI of 1.85.

SHOULDER

Record Plan Details

- Material - Base course Item 59TA, Stabilized Gravel-Mixed Bituminous Treatment (including shoulders); wearing course not detailed.

- Thickness - 2-1/4 inches to 3 inches on outside.
- Outside Width - 8 feet
- Median Width - 4 feet

Results of Shoulder Coring

Four shoulder cores were obtained with widely different materials encountered. These included 1 inch of top course over 1 inch of tar stabilized gravel, a single surface treatment over 2-1/4 inches of Item 59WW, 1-1/2 inches of top course over 3 inches of open base course, and full depth (3-1/2 inches) of top course.

Field Observations

General Evaluation - Poor

Outside Shoulder

- Surface wearing course - poor condition to non-existent.
- Variable depth drop-off exists at the edge of pavement - maximum 4 inches; the drop-off is now being corrected by Maintenance.

Median Shoulder

- The wearing course is generally good with occasional ravelled areas. Maximum drop-off of 1/2 inch.

FARC 57-42, BLOOMINGBURG - MONTICELLO, PART 2; MONTICELLO VILLAGE
MONTICELLO - LIBERTY, PART 1
ROUTE MILE MARKER 17-9609 - 1267 TO 1319

PAVEMENT

Features

- Portland cement concrete pavement, 100 foot nominal length slab.
- Formed joints sealed with liquid sealer.

Field Observations

The transverse joints show faulting in the driving lane of 1/8 to 1/4 inches and in the passing lane from 0 to 1/4 inches.

Many transverse cracks are present in the slabs in some areas. These transverse cracks have faulted. Faults as great as 5/8 to 3/4 inches were observed.

The faulted transverse joints and transverse crack faulting has created an objectionable ride.

There were nine blowup repairs noted in this section, generally a single lane in width. The blowups have resulted in slab displacement and opening and separation of the longitudinal joints. In one area the eastbound longitudinal joint is open approximately 1-5/8 inches for about a mile in length.

Pavement wear ranges from slight to exposed coarse aggregate in the driving lane wheel tracks.

Pavement Rideability Index

Eastbound - The complete 5.082 miles was surveyed and had a mean PRI of 0.31.

Westbound - The mean PRI of the 5.075 miles was 0.21.

SHOULDER

Record Plan Details

- Material - Base Course Items 73A and 74B; wearing course Item 55S, double surface treatment.
- Thickness - 6 inches
- Outside Width - 8 feet
- Median Width - 4 feet to 8 feet

Results of Shoulder Coring

Four cores were obtained on this section. The shoulder section consisted of 1 to 1-1/2 inches of top course over gravel.

Field Observations

General Evaluation - Good

Outside Shoulder

The asphalt concrete is generally good, with isolated locations of ravelling of the outside edge. Localized drop-off - generally a maximum 1/2 inch - is a minor problem except between MP 1290 - 1292 where the drop-off is 2 inches.

Median Shoulder

The wearing course is generally non-existent.

EARTH CUT SLOPES

WB 1305

The cut slope has continued to slough over a long period of time. Maintenance forces have erected a concrete crib wall at the toe of slope to retain the sloughed material. As more material sloughs, the wall is increased in height by adding more members. The wall is currently on a negative batter.

FARC 50-52, BLOOMINGBURG - MONTICELLO, PART 2, AND
FARC 55-42, BLOOMINGBURG - MONTICELLO, PART 2
ROUTE MILE MARKER 17-9609 - 1319 TO 1350

PAVEMENT

Features

FARC 50-52

- Portland cement concrete pavement, 100 foot nominal length slab.
- Formed joints sealed with a liquid sealer.

FARC 55-42

- Portland cement concrete pavement, 100 foot nominal length slabs. At MP 1338 eastbound newer concrete widening lanes have been added with 50 foot length slabs. The older lanes have formed concrete joints with liquid sealer. Neoprene sealer was used in the joints of the new slabs.

Field Observations

FARC 50-52

The liquid sealer has deteriorated and has been torn out by traffic.

Transverse joints show faulting of 0 to 1/8 inch in the driving and passing lanes.

There are transverse cracks present in the slabs at about a 20 foot spacing. Some of these cracks have minor faulting.

Eight blowup repairs were noted in this section, generally a single lane in width.

The longitudinal joint has spread apart 1 to 1-1/2 inches wide in one area.

Pavement wear shows as exposed coarse aggregate across the entire driving lane.

FARC 55-42

The liquid sealer in the older lanes has deteriorated and has been lost, while the neoprene sealer in the new lanes is in good condition.

Transverse joint faulting is about 1/8 inch in both the driving and passing lane.

Transverse cracks at about 30 foot spacing are present in the slabs; some show faulting of 1/4 inch.

The longitudinal joint has spread apart 1 inch in some areas.

Twenty three blowup repairs were noted in this section. Blowups occurred generally in single lane widths.

There is pavement wear in the driving lane wheel paths. Some sections have been grooved longitudinally.

Pavement Rideability Index

Eastbound - The mean PRI for this segment was 1.08. The .281 miles of rigid pavement had a mean PRI of .75 and the 2.668 miles of overlaid pavement had a mean PRI of 1.11.

Westbound - The mean PRI was 1.83 with the 2.205 miles of rigid pavement rated at 1.85 and the .673 miles of overlaid pavement rated at 1.76.

SHOULDER

Record Plan Details

- Material - Base Item 259G, Calcium Chloride Treated Gravel, outside shoulder.

- Thickness - 9 inches

- Outside Width - 10 feet

- Median Width - 4 feet

Results of Shoulder Coring

FARC 50-52

Two cores were obtained on this section. The shoulder section consists of 3/4 to 1-3/4 inches of top course over 3-1/2 to 4-1/2 inches of open base course. The total thickness is between 5 and 5-1/4 inches.

FARC 55-42

Three cores were obtained on this section. Two cores indicate 3/4 to 1-1/4 inch of top course over gravel. One core consists of 1-1/2 inches of top course over 4 inches of open base course.

Field Observations

General evaluation - variable from good to poor

Outside Shoulder

- Where the evaluation is good (approximately 5/6 of the shoulder mileage) the surface wearing course is intact.

- Where the evaluation is fair (approximately 1/6 of the shoulder mileage) the wearing course is alligator cracked to different degrees.

- Drop-off at the shoulder-pavement interface is between 1/4 and 1/2 inch.

Median Shoulder

- General evaluation is good

FARC 56-8P, BLOOMINGBURG - MONTICELLO, PART 1 & 2

ROUTE MILE MARKER 17-9609 - 1350 TO 1435

PAVEMENT

Features

- Portland cement concrete pavement, 100 foot nominal slabs.

- Formed concrete expansion joints were used with liquid sealer.

Field Observations

No effective sealer was present in the joints; only portions were still present.

Transverse joint faulting ranged from 0 to 1/4 inch in the driving lane and 0 to 1/8 in the passing lane. The section of road over the Shawangunk Mountains was generally in good condition with no noticeable faulting.

A core taken in the area of the Shawangunk Mountains shows a different transverse joint load transfer device than that found in other contracts. It is similar to Figure No. 6, a Two-Piece Malleable Iron Sleeve, noted in Physical Research Report 66-2. See Page 25. This joint device and other factors have given good service in this particular area. However, some minor faulting can still be attributed to this style of joint in other areas of the contract.

Transverse cracks were present in areas at about a 25 foot spacing; some have faulted as much as 1/2 inch. The transverse cracks seem to have relieved the pressures inducing faulting at the constructed transverse joints, but in so doing have incurred faults at each transverse crack.

The longitudinal joint shows spreading of about 1/2 inch in some areas.

Twelve blowup repairs were noted in this section, generally in single lane widths.

The pavement shows traffic wear in the driving lane wheel paths.

Many pavement sections on curves have been grooved longitudinally.

Pavement Rideability Index

Eastbound - The mean PRI was 1.12 for the 8.551 miles rated. The 8.085 miles of rigid pavement had a mean PRI of 1.14 and the .466 miles of overlaid pavement had a mean PRI of .68.

Westbound - The mean PRI was 1.26 for the 8.200 miles rated. The 8.166 miles of rigid pavement had a mean PRI of 1.26 and the .34 miles of overlaid pavement had a mean PRI of 1.24.

SHOULDER

Record Plan Details

- Material - Item 259G, Calcium Chloride Treated Gravel (outside shoulder).
- Thickness - Base 9 inches; wearing course not detailed.
- Outside Width - 10 feet
- Median Width - 4 feet Item 259L (gravel inside shoulder) 9 inches thick.

Results of Shoulder Coring

Four cores were obtained on this section. Three cores indicate 3/4 to 2-1/4 inches of top course over gravel. One core consists of 4-1/2 inches of armor coat over gravel.

Field Observations

General evaluation is good to fair

Outside Shoulder

- Surface wearing course varies from intact to non-existent.
- More than one shoulder mile exhibits ravelling or eroded conditions caused by poor surface drainage in the outside 2 feet of shoulder.
- Drop-off problems exist for more than one shoulder mile - maximum 2 inches.

Median Shoulder

- General evaluation is good

FARC 56-80, BLOOMINGBURG - MONTICELLO, PART 1; MIDDLETOWN - BLOOMINGBURG
BLOOMINGBURG - BULLVILLE: GOSHEN - FAIR OAKS, PART 3
ROUTE MILE MARKER 17-9609 - 1435 TO 1458 (EXIT 115)

PAVEMENT

Features

- Portland cement concrete pavement with 100 foot nominal length slabs.
- Formed pavement joints and liquid sealer was used in the original construction.

Field Observations

Generally the pavement is in good condition.

The joint sealer has deteriorated and has been lost.

Transverse joint faulting of 1/8 to 1/4 inch was noted in the driving lane and about 1/8 inch in the passing lane.

Blowup repairs were not noted in this section.

There are some transverse cracks that have minor faulting.

The longitudinal joint shows spreading of about an inch for about 1 mile in length eastbound to the County Line.

There is minor pavement wear in the driving lane wheel paths. Sections of pavement have been grooved longitudinally.

Pavement Rideability Index

Eastbound - The mean PRI of the 2.224 miles of rigid pavement was 2.53.

Westbound - The mean PRI of the 2.226 miles of rigid pavement was 2.17.

SHOULDER

Record Plan Details

- Material - Base Item 259, Calcium Chloride Treated Gravel (outside shoulder).
- Thickness - Not detailed
- Outside Width - 10 feet

- Median Width - 4 feet

Results of Shoulder Coring

Four cores were obtained on this section. They indicate 1 to 1-1/2 inches of top course over gravel.

Field Observations

General Evaluation - fair with poor sections

Outside Shoulder

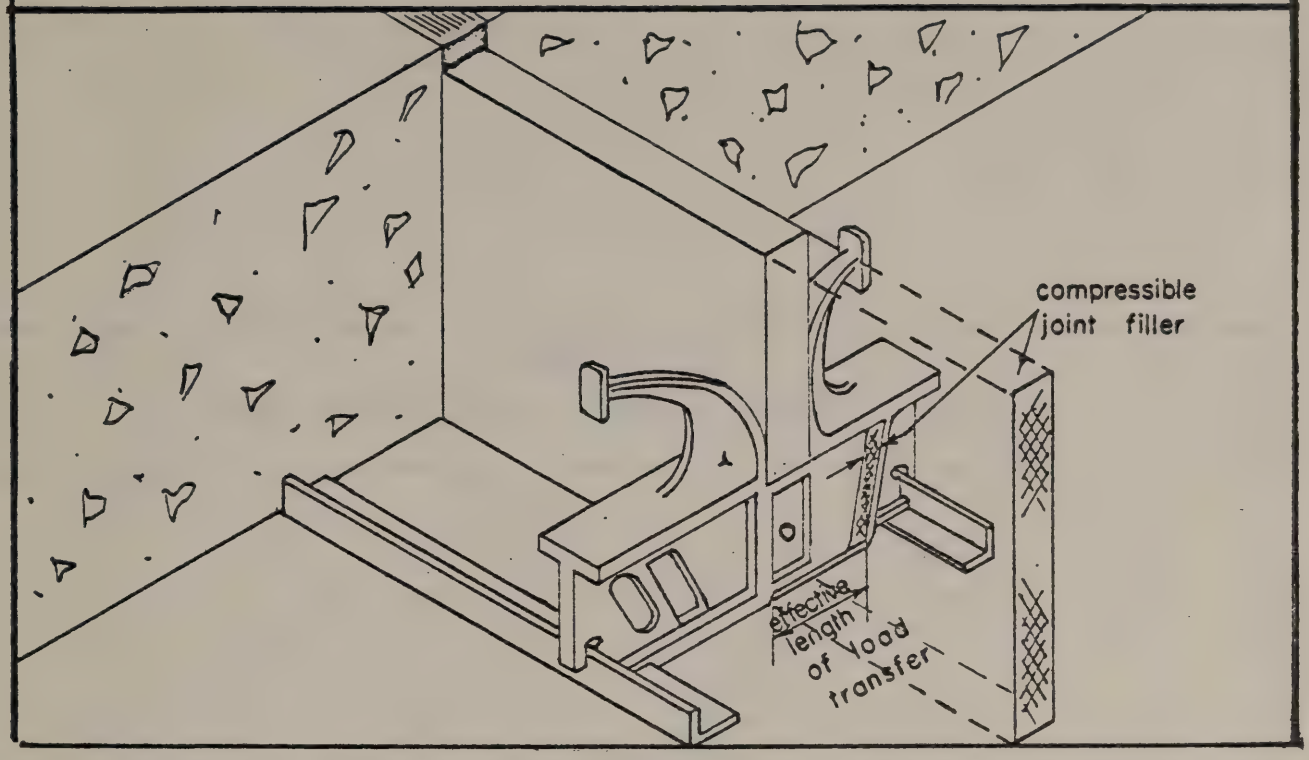
- In general, the outside several feet of shoulder has had the surface worn away and several feet adjacent to the pavement is severely alligator cracked with complete failure being imminent.

Median Shoulder

- General evaluation is good

Figure No. 6

TWO-PIECE MALLEABLE IRON SLEEVE



(From NYSDPW Physical Research Report 66-2)

Figure No. 7

HAIRPIN DOWELS

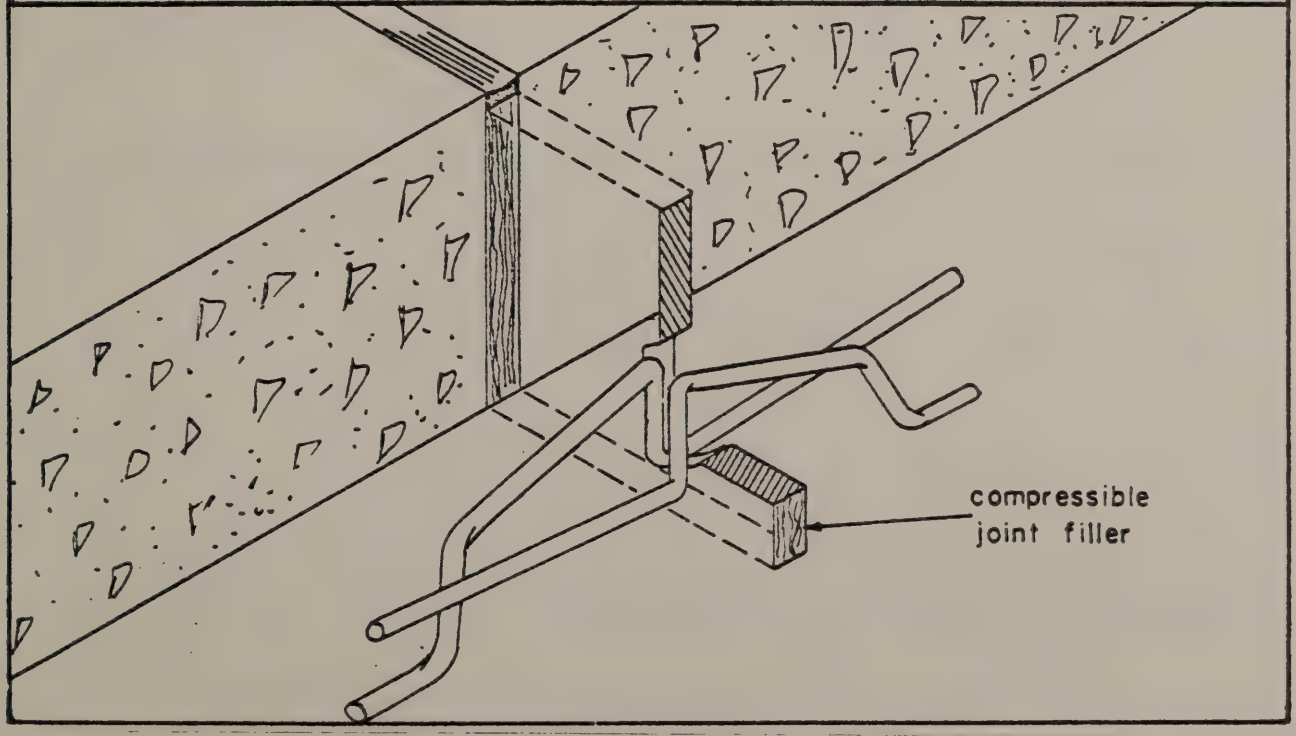
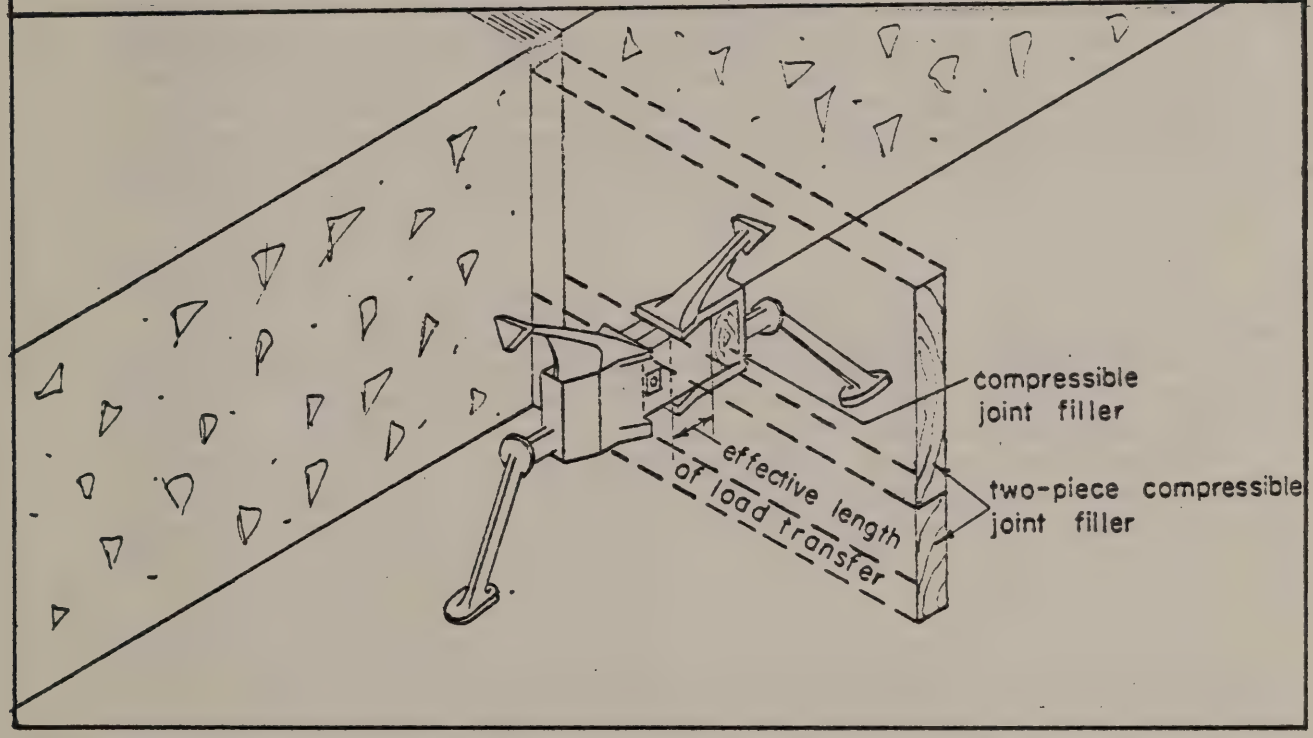


Figure No. 8

TWO-PIECE MALLEABLE IRON SLEEVE



"Acme" Type Load Transfer Device
(also used in contraction joints)

(From NYSDPW Physical Research Report 66-2)

IV. TYPES OF PROBLEMS OBSERVED

PAVEMENT

Pavement problems identified on Route 17 in Sullivan County are as follows:

Joint Seals

Joint seals are an observed problem. On many of the projects, the sealers, both liquid and neoprene, have deteriorated to an extent where they are no longer effective. The hardening of the asphalt sealer and compression set of neoprene are typical failures as these materials reach the end of their service life. As the sealers "set" or harden, openings at the slab-sealer interface occur. Traffic will eventually tear out the sealer leaving the joint open. These openings have allowed in water, deicing salts, abrasives, and road dirt. This in turn has caused corrosion and weakening of the load transfer device and can affect subgrade support which leads to faulting. It can also cause blowups due to incompressibles filling the joint and can cause transverse cracks as the corroded load transfer devices "freeze" and lock the joint.

Joint Faulting

A problem that has affected all the projects in the county is transverse joint faulting. This problem was found in both the newer and older projects. Faulting is caused by failure of the load transfer device which is due to corrosion, loss of subgrade support and heavy traffic loading. Though three different types of load transfer devices were found by coring, all projects were affected by the faulting problem. The faults range in degree from those that do not affect the ride to those where the ride is objectionable.

Pavement Blowup

Another type of problem noted was pavement blowups. The blowup problem is more extensive in projects greater than 20 years old. With time the transverse joint seals deteriorate and are no longer effective. The joints then are filled with incompressibles such as abrasive sand used during the winter. High summer pavement temperatures cause expansion of the slabs that is relieved by a shattering or buckling type blowup.

The blowup in turn causes other problems to the pavement. When the blowup occurs in a single lane of a multiple lane pavement, differential slab movement occurs. The slabs move in toward the blowup, and the longitudinal joint ties which have been weakened by corrosion pull-out and bend. When this happens, the keyway separates and load transfer in the longitudinal joint is lost. The longitudinal joint spreads apart and subsequently fills with fines as noted in areas of projects affected by blowups. Many of the older pavements are more susceptible to the longitudinal joint spreading since the pavement was formed a lane at a time and the ties were

two-piece with threaded connectors. The threads are deteriorated by corrosion which leads to the pull-out and joint separation.

When the slabs move in toward the blowup, the transverse joints open. The largest opening is seen in the joints closest to the blowup. The openings diminish as the distance away from the blowup increases. If the openings exceed the travel length of the load transfer device, transverse load transfer is also lost. This was also noted in some areas.

Transverse Pavement Cracking

Transverse pavement cracking was another problem noted in many projects. The cracking ranged from a few cracks over cross culverts to cracking at 15 foot - 20 foot ± intervals. The cracking over culverts seems to be a "normal" phenomenon and since its extent is relatively small, it can be ignored for this report.

Transverse cracks that have faulted are a problem and have contributed to an objectionable ride. The pavement reinforcing mesh has probably corroded due to exposure at the crack allowing the slab portions to separate. Traffic loads over a period of time have caused the loss of load transfer provided by aggregate interlock.

Pavement Surface Wear

Wear in the pavement was not judged to be a problem. Significant rutting was not noted. Wet weather problem areas appear to have been rectified by the longitudinal pavement grooving that was observed on curves.

Skid Resistance

Skid resistance measurements have not been taken on this section of Route 17. Therefore, this has not been considered as a factor in the solutions that follow. Skid resistance measurements can be done upon request. We would recommend the tests be run on sections of pavement whose surface will remain exposed and not be overlaid.

SHOULDERS

Shoulder problems observed are summarized below.

Loss of Wearing Course

The most frequently occurring problem was loss of the wearing course. This loss appeared to be due to both aging and erosion. As the asphalt double surface treatment ages, it hardens and cracks permitting water to infiltrate the surface. Subsequent frost action wedges the particles apart and traffic abrades the material. The erosion has occurred at the outside edge of the shoulder. Abrasive sand placed during the winter has accumulated for years resulting in a berm outside the shoulder which channels the water along the shoulder edge. The abrasive sand has accumulated significantly at guide rail locations. Concentrated flow

erodes the soil outside the stabilized shoulder, undercutting the shoulder and initiating ravelling.

Pavement Edge Drop-off

Drop-off at the shoulder-pavement interface varied considerably in magnitude. Drop-off is believed to be primarily caused by consolidation of shoulder and subgrade courses under load.

Longitudinal Shoulder Cracking

Where a hot mix asphalt material was used as the wearing course or for the complete shoulder section, longitudinal cracking located within two feet of the shoulder-pavement interface is common. This cracking is a result of frost action. Due to the color difference between the Portland cement concrete pavement and the black asphalt shoulder, more freeze-thaw cycles occur beneath the shoulder. This fact coupled with the abrupt change in materials and the availability of water results in a differential frost heave. The hot mix asphalt shoulder material rises and is broken when traffic, including snowplows, encroach on the shoulder. Tension cracks are left as a result. This problem is common Statewide for asphalt shoulder material adjacent to Portland cement concrete pavement.

Subsurface Water

Very few areas were observed where distress could be directly related to internal water problems. "Blowholes" in the shoulder at faulted transverse joints were not observed.

EARTH CUT SLOPES

The earth cut slopes are generally stable. Some of the slopes appear wet and may have bulged slightly since they were constructed, but are considered in satisfactory condition.

One cut slope on FARC 64-109 needs remedial treatment.

One unstable cut slope on FARC 57-42 has been treated by Maintenance forces by erecting a concrete crib wall. Specific recommendations will be made under separate cover which will include removing the wall.

ROCK CUT SLOPES

There were twenty-nine separate rock cut locations which were inspected and commented on by Engineering Geologists from the Soil Mechanics Bureau. A memorandum containing their observations and recommendations is included in the Appendix. Conditions at 20 of the locations are satisfactory and no work is recommended. At the remaining nine locations, occasional falling rock reaching the pavement or filling the ditches have been reported. Comments from the Assistant Resident Engineer on operational difficulties with snow

and ice problems are also reported. If treatment is considered necessary at any of these locations, preliminary recommendations range from scaling of unstable rock to complete reconstruction of the rock face.

SURFACE DRAINAGE

The ditches in some cut sections have become silted in and choked with weeds resulting in ponded water.

Accumulated abrasive sand outside the shoulder has concentrated surface drainage resulting in damage to the shoulder.

CULVERTS

Culverts and cross drains were not inspected.

V. RECOMMENDED PROBLEM SOLUTIONS

Solutions to the observed pavement problems fall into two categories depending on the age and the degree of the problem.

Newer pavements, those less than twenty years old, generally have the following types of problems:

- Joint faulting
- Transverse cracking
- Some blowups and potential blowups
- Joint seals past their service life

Older pavements, over twenty years old, have the following types of problems:

- Joint faulting
- Transverse cracking with faulting
- Blowups with related joint and slab separation
- Unsealed joints

In both the newer and older categories, joint faulting has created an objectionable ride. Faulting of transverse cracks in the older pavements has also added to the objectionable riding quality. The PRI data which is part of this report is a good reference for the designer to judge the degree of rideability for a section of pavement under study. However, this data is now 2 years old. Data from the 1978 Survey will be available soon. The 1979 Survey is underway.

Pavement blowups have caused transverse joint separation and longitudinal joint separation when the blowup occurs in only one lane. The older pavements have more frequent blowups associated with them. Their slab separation is also more severe as more time has elapsed for the joints to fill and cause the slab spreading.

Newer Pavements

In the newer pavements the recommended action to rehabilitate the riding qualities and to prevent unplanned hazardous blowups is as follows:

- Install 10 foot wide pressure relief joints at mainline structures and at intervals of 1000 to 1500 feet. These joints would protect the structures and prevent future hazardous pavement blowups. Transverse joint openings will occur, but these are judged to be less of a problem than blowups. After pressure relief joints are installed at the structures, existing blowup repairs can be replaced and utilized as a pressure relief joint. Dense base or dense binder asphalt concrete can be used to fill the joint. Its 10 foot width will allow compaction with a full size vibratory roller in thick lifts. All pressure relief joints should be the full width of the pavement to prevent differential lane movement.

- Grind faulted transverse joints using diamond bladed saws. This is currently being recommended for sections of I-84 and a specification is now being written.

- Pavement sub-sealing at the joints is being considered for I-84 work. We have no recommendation at this time whether this is necessary. As experience is gained after the I-84 contract work is let and underway, a recommendation will be made.

- Clean and seal all joints and cracks in the pavement. The transverse and longitudinal pavement joints as well as the joint between the shoulder and pavement should be sealed with a liquid sealer. The hot poured polyvinyl chloride coal tar sealers studied in Research Report ERD-77-RR-49 are recommended. Only cracks over 1/8 inch wide should be sealed. This would require a special specification.

This treatment will alleviate the objectionable ride due to the transverse joint faulting and prevent hazardous pavement blowups. It is a rehabilitation treatment to gain additional pavement life from the projects in this category.

Older Pavements

The recommended action for older pavements to rehabilitate the riding quality, prevent hazardous blowups and to strengthen free floating pavement slabs is an asphalt overlay. No other effective, economical treatment exists to repair the number and type of joint and other failures in the older pavements.

Preparation before overlaying should consist of:

- Replace existing blowup repairs with 10 foot wide full depth asphalt concrete. Dense base or binder should be used. These will also serve as pressure relief joints. Pressure relief joints should be installed at 1000 to 1500 foot spacing. However, since the blowups are so frequent on these older pavements very few, if any, additional pressure relief joints may be necessary. All the pressure relief may have taken place with the number of blowups that have occurred. Pressure relief joints should be the full width of the pavement to prevent differential lane movement.

- Clean and seal all longitudinal and transverse joints and cracks. The standard specification Item 633.03 or 633.04 should be used.

- The faulted joints and cracks should be shimmed with Type 5 Asphalt Concrete Shim Course. Only faulting over 1/4 inch should be repaired in this manner. An optional method of repairing these faults would be to mill or grind them.

- An Asphalt Tack Coat should be applied to the concrete in the areas where shimming is done. It should also be applied over the concrete pavement and shimmed areas before overlaying.

- The asphalt overlay should be a nominal 4-1/2 inch thickness consisting of a minimum 1-1/2 inch thickness of Dense Binder as a Trueing and Leveling Course, followed by a 1-1/2 inch layer of Dense Binder and a 1-1/2 inch layer of Top Course. To insure proper compaction, the special specification 18403.1799 for Type 6F Top Course may be used as Regional inspection manpower permits.

This overlay method of rehabilitation will probably be necessary on projects from Exits 101 to 112. It will alleviate the objectionable riding qualities, substantially reduce surface water infiltration and strengthen the many cracked and separated pavement slabs. It will provide additional years of service for a pavement which has passed its service life.

Two new techniques have been used as a means of eliminating reflection cracking in asphalt overlays: pavement breaking and seating; pavement overlay joint sawing and sealing. These techniques should be considered on a case by case basis during the design phase. Concrete pavement that has transverse cracking at closely spaced intervals (15 - 20 feet) will provide a natural substitute for pavement breaking. In effect the pavement has already been broken in smaller segments reducing the amount of expansion and contraction which causes reflective cracking. Pavement seating may be necessary on a limited basis.

Technical Services' personnel will be available to discuss this and formulate design warrants for use of these techniques.

A repair strategy that does not fit the general categories above for the present asphalt overlay on FARC 50-10, MP 1109-1127 follows. Remove the 1 inch top course and 1-1/2 inch open binder course using asphalt milling equipment. This material could be recycled in a Dryer Drum Hot Mix Plant and used as a 1-1/2 inch thick asphalt dense binder which could then be covered with a new 1 inch thick asphalt top course. This would eliminate the alligator cracking at the joints and provide more years of service with less maintenance. In this manner the existing shoulders could be saved.

PAVEMENT EDGE DRAINS

The observed field conditions do not justify significant quantities of pavement edge drains. However, it is anticipated some will be necessary at selected locations determined during design.

SHOULDERS

The amount and type of shoulder work required is directly related to the planned pavement treatments; specifically, whether the pavement is to be overlaid or not. The recommended actions follow:

General

Remove all accumulated debris and abrasive sand from the existing shoulder surface; similarly this material should be removed from outside the shoulder where it retards surface drainage to the ditch. On fill sections particularly, water should be able to drain off the shoulder and down the embankment slope as sheet flow.

Pavement to be Overlaid

The pavement overlay should be carried across the existing shoulders to attain the desired cross slope. Preparatory work will include brooming all loose material from the shoulder, placing a trueing and leveling course or another hot mix asphalt item in low, discontinuous areas to attain a satisfactory surface to insure proper compaction of the pavement overlay. Removal of the existing shoulder wearing course or base course is not necessary.

Pavements Not to be Overlaid

The shoulder surface should be broomed to remove all loose material including debris and abrasive sand. Isolated areas of ravelling and pot-holing should have sufficient material removed to place a proper patch of asphalt concrete 2-1/2 inches thick. Areas having a significant amount of drop-off (1 inch or more) should be overlaid to restore grade. Any significant joint opening at the shoulder-pavement interface should be sealed with a hot poured polyvinyl chloride coal tar sealer. The entire shoulder surface should then be sealed with a single surface treatment.

CUT SLOPES

Rock

Decisions on whether to do this work is subjective in terms of cost-benefit. Detailed recommendations will be made during design upon request.

Earth

The earth slopes are stable and performing satisfactorily; no treatment is recommended. There are two areas of exception: EB 1029 and WB 1305. Detailed recommendations will be made for these areas during design.

SURFACE DRAINAGE

Ditches which have interrupted surface drainage in cut sections should be cleaned.

APPENDIX A

PHOTOGRAPHS

NO PHOTOGRAPHS INCLUDED

APPENDIX B

LOCATION OF FIELD INVESTIGATIONS

APPENDIX C

GEOLOGY REPORT

MEMORANDUM
DEPARTMENT OF TRANSPORTATION

DATE July 31, 1979

SUBJECT PRELIMINARY ROCK SLOPE INSPECTION
ROUTE 17 - DELAWARE COUNTY LINE TO ORANGE COUNTY LINE
REGION 9, SULLIVAN COUNTY

FROM A. B. Klussendorf, Senior Engineering Geologist ABK

TO E. M. Moody, Associate Soils Engineer ←

Various rock slopes along the subject portion of Route 17 were inspected on June 20, 1979, by J. Driscoll, Assistant Sullivan County Resident Engineer; W. Orshall, Region 9 Soils; and J. Howe and the writer of Main Office Soils. The purpose of the inspection was to delineate rock slope areas deemed to be safety hazards and to determine appropriate treatment. Mr. Driscoll indicated those locations where rock falls occur and where the slopes are a problem for other reasons.

The following listing covers all of Route 17 in Sullivan County with the exception of certain portions which are either under contract or have already been designed. Recommendations given are preliminary in nature and are intended to indicate those locations where rock slope improvements would result in improved highway safety. Recommended rock slope design inclinations are given for locations (where setback from the edge of pavement is less than 30 feet) for possible application if it is elected to recut slopes to gain additional snow storage or by reason of removal of hazardous fixed objects. In the event that any of these rock slopes is recut it is recommended that the toe of slope be moved back no less than five feet to assure adequate burden for effective presplitting. Cross sections will be necessary for any rock slope to be recut.

In general ditches should be kept clear of fallen rock "piles" at the toe of rock slopes as they tend to become "launching pads" which may allow additional falling rock to bounce toward the pavement.

FARC 65-151, M.M. 100.0 (Delaware Co. Line) to M.M. 101.3

Mile Marker 100.0±, EB (Delaware County Line) -- Approximate ±50 foot high vertical sandstone slope -- existing setback from the edge of pavement is ±35 feet -- some rock falls have occurred at this location but the "fall out zone" is good and no rocks reach the pavement -- this rock slope does not appear to be a problem and no rock slope treatment is deemed necessary.

Mile Marker 100.8±, EB -- Approximate ±45 foot high vertical sandstone slope -- existing setback from the edge of pavement is ±27 feet -- some rock falls have occurred but the "fall out zone" is adequate and no rock reaches the pavement -- Mr. Howe suggested that a small size stone lining of the ditch at this location would be beneficial to assure that any future falling rock would not bounce. No other rock slope treatment is deemed necessary. If this slope were recut, the design slope inclination should be no steeper than 3 vertical on 1 horizontal.

FARC 64-109, M.M. 101.3 to M.M. 107.4

Mile Marker 103.3±, EB -- Approximate ±15 foot high vertical sandstone slope -- existing setback from the edge of pavement is ±25 feet -- this rock slope does not appear to be a problem and no slope treatment is deemed necessary. If this slope were to be recut the design inclination should be no steeper than 3 vertical on 1 horizontal.

Mile Marker 105.9±, EB -- Approximate ±15 foot high vertical sandstone slope -- existing setback from the edge of pavement is ±18 feet -- this slope does not appear to be a problem and no slope treatment is deemed necessary. If this slope were to be recut the design inclination should be no steeper than 3 vertical on 1 horizontal.

FARC 61-132, M.M. 107.4 to M.M. 110.9

Mile Marker 107.9±, EB -- Interbedded shale and sandstone slope -- existing setback from the edge of pavement is ±35 feet -- this slope does not appear to be a problem and no slope treatment is deemed necessary.

Mile Marker 108.5±, EB -- Approximate ±35 foot high sandstone slope -- existing setback ±21 feet -- this slope does not appear to be a problem and no slope treatment is deemed necessary. If this slope were to be recut the design inclination should be no steeper than 3 vertical on 1 horizontal.

Mile Marker 108.9±, WB -- Approximate ±50 foot high sandstone slope -- existing setback from the edge of pavement is ±30 feet -- this slope does not appear to be a problem and no slope treatment is deemed necessary.

Mile Marker 110.2±, WB -- Low sandstone slope -- existing setback from the edge of pavement is ±25 feet. This slope does not appear to be a problem and no slope treatment is deemed necessary. If this slope were to be recut the design inclination should be no steeper than 3 vertical on 1 horizontal.

FARC 50-10, M.M. 110.9 to M.M. 112.7

Mile Marker 111.5±, EB -- Approximate ±10 feet high sandstone slope -- setback from the edge of pavement is ±9 feet and guide rail is located along toe of slope. This slope does not appear to be a problem and no slope treatment is deemed necessary. If this slope were to be recut the design inclination should be no steeper than 3 vertical on 1 horizontal.

FARC 56-87, M.M. 112.7 to M.M. 118.6

Mile Marker 118.2±, EB -- Approximate ±12 foot high sandstone and shale slope -- existing setback from the edge of pavement is ±15 feet -- guide rail is located along the toe of slope. This slope does not appear to be a problem and no slope treatment is deemed necessary. If this slope were to be recut the design inclination should be no steeper than 3 vertical on 2 horizontal.

FARC 58-104, M.M. 118.6 to M.M. 126.7

Mile Marker 119.2±, EB -- Approximate ±8 foot high sandstone slope -- existing setback from the edge of pavement is ±22 feet -- guide rail is located along the shoulder and a transmission line crosses overhead. This slope does not appear to be a problem and no slope treatment is deemed necessary. If this slope were to be recut the design inclination should be no steeper than 3 vertical on 2 horizontal.

Mile Marker 119.2±, WB -- Approximate ±20 foot high sandstone and shale slope -- existing setback from the edge of pavement is ±23 feet -- guide rail is located along the shoulder and a transmission line crosses overhead. This slope does not appear to be a problem and no slope treatment is recommended. If this slope were to be recut the design inclination should be no steeper than 3 vertical on 2 horizontal.

Mile Marker 125.9±, EB -- Approximate ±12 foot high sandstone slope -- existing setback from the edge of pavement is ±19 feet -- guide rail is located along the shoulder. This slope does not appear to be a problem and no slope treatment is recommended. If this slope were to be recut the design inclination should be no steeper than 3 vertical on 2 horizontal.

Mile Marker 125.9±, WB -- Approximate ±12 foot high sandstone slope -- existing setback from the edge of pavement is ±17 feet -- guide rail is located along the shoulder. This slope does not appear to be a problem and no slope treatment is deemed necessary. If this slope were to be recut the design inclination should be no steeper than 3 vertical on 2 horizontal.

Mile Marker 126.3±, EB and WB -- Approximate ±80 foot high shale and sandstone slopes -- existing setback from the edge of pavement is ±18 feet -- guide rail is located along both shoulders. The shale ravels and rock falls have reached the highway shoulders. They could easily reach the pavement. The presence of the guide rails interferes with cleanup of the rock debris at the toe of slope. This cut should be reconstructed such that the slopes are no steeper than 3 vertical on 2 horizontal, and preferably at 1 vertical on 1 horizontal. On the south side (EB) a bench 25 feet wide minimum should be constructed approximately ahlf way down the slope.

FARC 57-42, M.M. 126.7 to M.M. 131.8

Mile Marker 131.7±, EB -- Approximate ±35 foot high shale and sandstone slope -- existing setback from the edge of pavement is ±19 feet -- an overpass over Route 17 is located midway in this cut. This slope does not appear to be a problem and no slope treatment is deemed necessary. If this slope were to be recut the design inclination should be no steeper than 1 vertical on 1 horizontal.

Mile Marker 131.7±, WB -- Approximate +35 foot high shale and sandstone slope -- existing setback from the edge of pavement is ±19 feet. A minor amount of rock has fallen from this slope but none reaches the highway shoulder. This slope is not considered to be a problem and no slope treatment is deemed necessary. If this slope were to be recut the design inclination should be no steeper than 1 vertical on 1 horizontal.

FARC 55-42, M.M. 132.2 to 135.0

Mile Marker 132.5±, EB -- Sandstone and shale slope -- existing setback from the edge of pavement is ±25 feet. Rock falling from the upper portion of this slope has reached the pavement. It is recommended that the sandstone blocks at the top of this slope be removed by blasting. If this slope were to be recut the design inclination should be no steeper than 3 vertical on 2 horizontal.

Mile Marker 132.5±, WB -- Approximate ±80 foot high sandstone and shale slope -- existing setback from the edge of pavement is ±18 feet -- a telephone line is located at the base of this slope. Rock falling from this slope does reach the pavement. It is recommended that this slope be stabilized by shooting off existing overhangs together with scaling and rock bolting. If this slope were to be recut the design inclination should be no steeper than 3 vertical on 2 horizontal.

Mile Marker 132.7±, WB -- Approximate ±45 foot high sandstone slope -- existing setback from the edge of pavement is ±14 feet. Some rock has fallen from this slope in the past and has reached the pavement. It is recommended that this slope be stabilized by shooting off some of the overhangs together with scaling and bolting. Mr. Driscoll indicated that snow and ice is a problem at this location and that he would like this slope to be recut to gain additional setback. If this slope were recut the design inclination should be no steeper than 3 vertical on 1 horizontal.

Mile Marker 133.3±, EB -- Approximate ±20 foot high sandstone and shale slope -- existing setback from the edge of pavement is ±17 feet. This slope does not appear to be a problem and no slope treatment is deemed necessary. If this slope were to be recut the design inclination should be no steeper than 3 vertical on 1 horizontal.

Mile Marker 133.3±, WB -- Approximate ±5 foot high sandstone slope -- existing setback is ±18 feet. This slope does not appear to be a problem and no slope treatment is deemed necessary. If this slope were to be recut the design inclination should be no steeper than 3 vertical on 1 horizontal.

Mile Marker 134.4±, EB and WB -- Sandstone and shale slopes (minor shale) -- existing setbacks from the edge of pavement are ±19 feet. A minor amount of rock has fallen from these slopes into the ditches. A moderate amount of rock should be scaled from the top of these slopes. If these slopes are to be recut the design inclination should be no steeper than 3 vertical on 1 horizontal.

FARC 56-8P, M.M. 135.0 to M.M. 143.5

Mile Marker 137.4±, EB and WB -- Approximate ±20 foot high sandstone slopes -- existing setbacks from the edge of pavement are ±17 feet. These rock slopes do not appear to be a problem and no slope treatment is deemed necessary. Mr. Driscoll indicated that snow and ice removal is a problem in this cut due to limited storage and he would like these slopes to be recut to gain additional setback. If these slopes were to be recut the design inclination should be no steeper than 3 vertical on 1 horizontal.

Mile Marker 139.9±, EB -- Approximate ±15 foot high sandstone slope -- existing setback from the edge of pavement is ±14 feet. The rock in this slope is highly jointed and fractured and an adverse structure dips toward centerline at approximately ±42°. The ditch at the toe of slope is presently filled in with rock debris and Mr. Driscoll reports continual problems with fallen rock. Rock falls from this slope do reach the pavement. The toe of this slope should be set back an additional 10 feet (minimum) from the edge of pavement. If this slope is to be recut the design inclination should be no steeper than 1 vertical on 1 horizontal.

Mile Marker 140.4 to 141.1, EB -- Approximate ±30 foot high sandstone slope -- existing setback from the edge of pavement is ±16 feet. Conditions are as at 139.9±, EB and the same recommendations apply.

Mile Marker 142.6±, EB -- High sandstone and conglomerate slope -- bedding is inclined toward centerline -- existing setback is ±18 feet. This slope has been previously stabilized by rock bolting and no problems are apparent. No further slope treatment is recommended. Recutting this slope does not appear a practical consideration.

Mile Marker 143.3±, EB and WB -- Approximate ±160 foot high sandstone thru cut -- existing setback from the edge of pavement is ±18 feet. The EB slope has previously undergone stabilization treatment and none is deemed necessary on the WB slope. The EB treatment consists of double (W) type guide rail placed partway up the slope on the old road grade which serves as a "fall out" zone. No further slope treatment is recommended. Recutting these slopes does not appear a practical consideration.

FARC 56-80, M.M. 143.5 to M.M. 145.7 (Orange Co. Line)

Mile Marker 143.6± to 143.8±, EB and WB -- Thru cut in interbedded shale and sandstone -- approximate slope height EB is ±120 feet; WB approximately ±75 feet. Existing setbacks from the edge of pavement are ±15 feet. An overpass crosses over Route 17 at the east end of this cut. Ditches at the toes of these slopes fill in with shale debris blocking drainage.

Mr. Driscoll reports continual maintenance problems cleaning out the ditches plus problems with snow and ice. The past winter the lack of room for storage caused snow and ice to accumulate one foot out onto the pavement. To gain additional snow storage and to eliminate drainage problems in the ditches it is recommended that these slopes be set back from the edge of pavement an additional 15 feet (minimum) on a 3 vertical on 2 horizontal design slope. From a maintenance point of view, guide rail should not be erected in this cut.

ABK:sd

APPENDIX D

SHOULDER CORE RECORDS

IINGBURG - MONTICELLO, PART 2

37-10
8-3.5
se
1 1/2
ase Course
4 1/2

13-1328EB
12-5
Top Course
1 3/4
Open Base Course
5 1/4

⑧ FAR

DEPTH - INCHES

0

ONTICELLO, PARTS 1 & 2

2EB

5

rmor Coat

lean Coarse Gravel

21-1425WB
8-4
Top Course
2 1/4
Gravel
5 1/4

22-1383WB
8-4
3/4
Top Course
Gravel
6 3/4

MONTICELLO, F

453EB

Top Course

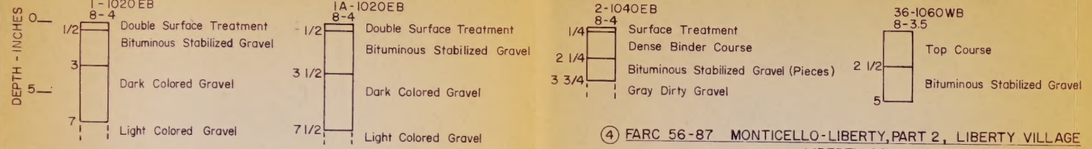
1

Gravel

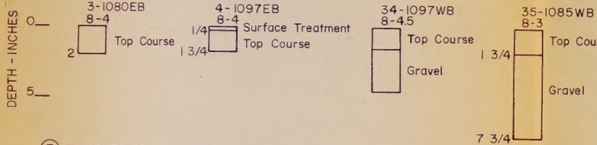
10+

SHOULDER CORE RECORDS

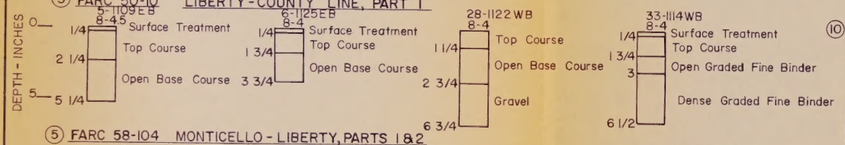
① FARC 64-109 LIBERTY-COUNTY LINE, PART 2, ROSCOE-DECKERTOWN



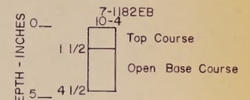
② FARC 61-132 LIBERTY-COUNTY LINE, PARTS 1 & 2



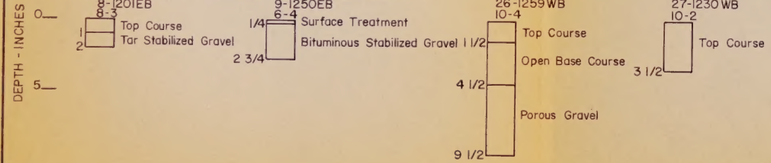
③ FARC 50-10 LIBERTY-COUNTY LINE, PART 1



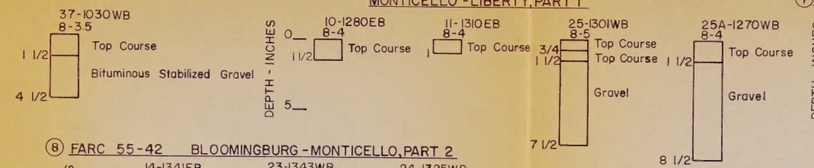
④ FARC 56-87 MONTICELLO-LIBERTY, PART 2, LIBERTY VILLAGE LIBERTY-COUNTY LINE, PART 1



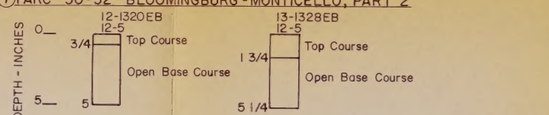
⑤ FARC 58-104 MONTICELLO - LIBERTY, PARTS 1 & 2



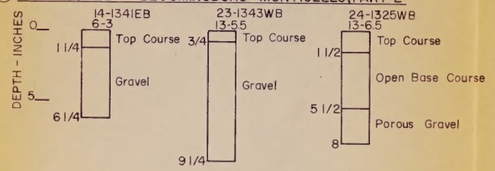
⑥ FARC 57-42 BLOOMINGBURG-MONTICELLO, PART 2, MONTICELLO VILLAGE MONTICELLO - LIBERTY, PART 1



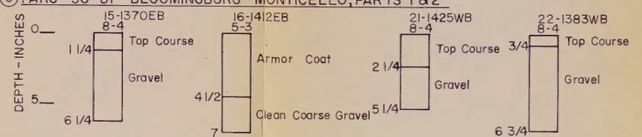
⑦ FARC 50-52 BLOOMINGBURG - MONTICELLO, PART 2



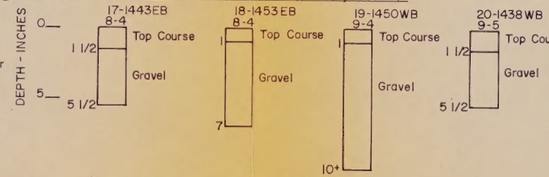
⑧ FARC 55-42 BLOOMINGBURG - MONTICELLO, PART 2



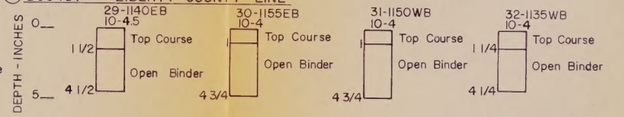
⑨ FARC 56-8P BLOOMINGBURG - MONTICELLO, PARTS 1 & 2



⑩ FARC 56-80 BLOOMINGBURG - MONTICELLO, PART 1



⑪ D95467 LIBERTY-COUNTY LINE



KEY

CORE NO. (1) ROUTE - MILE MARKER (1000)

SHOULDER WIDTH (FEET) DISTANCE FROM EDGE OF PAVEMENT (FEET)

(1) ORDER OF CONTRACTS FROM WEST TO EAST

SHOULDER CORE RECORDS